

Short Communication

New records of *Neogale frenata* and *Potos flavus* from Sierra Madre de Oaxaca, Mexico

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Abstract

We provide new records of *Neogale frenata* and *Potos flavus*, two carnivores with elusive behaviors that are challenging to observe in their natural habitats. Through direct records compiled in diurnal and nocturnal monitoring over three years, we record two individuals of *N. frenata*, a juvenile and an adult, and three individuals of *P. flavus*, an adult and two juveniles. The juvenile of *N. frenata* increases the distribution range to 68 km from its nearest record. The two juveniles of *Potos flavus* represent an extension of their distribution range of 22 km away from their nearest record. This new data highlights the importance of opportunistic records in combination with passive methods as part of fauna inventories. We emphasize the relevance of considering the habitat conditions of each record to identify possible threats to their conservation, like human disturbances.

Key words: Carnivora, direct records, free-ranging cats, habitat disturbance, Mustelidae, opportunistic records, Procyonidae, tropical montane cloud forest

The Long-tailed weasel, *Neogale frenata* (Lichtenstein, 1831), is a small-sized (30–55 cm total length, 170–280 g) mammal carnivore (Sheffield and Thomas 1997; Elsasser and Parker 2008). Its coloration is light or orange-brown in the dorsum with a cream-colored venter, the tip of the tail is black and is thin and almost the same length as the body, and on the face it has a white mask bordered by black (Sheffield and Thomas 1997). It occurs from southern Canada, Mexico, and Central America to northern South America at altitudes from sea level to about 4,200 m (Sheffield and Thomas 1997; Helgen and Reid 2016). *Neogale frenata* inhabits a wide array of habitats from nearly intact forests to semi-urbanized areas (Sheffield and Thomas 1997; Harding and Dragoo 2012). It is found in many Mexican states, with no documented records in Baja California Sur and certain regions of Coahuila, Chihuahua, and Sonora (Ruiz-Campos

et al. 2009). In Sierra Madre de Oaxaca, it has been previously recorded in the municipalities of San Juan Bautista Valle Nacional, Santiago Comaltepec, and San Felipe Usila, however, in the case of San Felipe Usila it has only been mentioned but no geographical references are included (Table 1).

On the other hand, the Kinkajou, *Potos flavus* (Schreber, 1774) is a small procyonid with nocturnal and arboreal habits (Ford and Hoffmann 1988). It has rounded ears, a prehensile tail, a long and flexible tongue, and wooly fur (Ford and Hoffmann 1988; Sampaio et al. 2011; Miranda et al. 2018). Pelage coloration is predominantly yellowish, tawny or reddish, but a black mid-dorsal stripe is present in some individuals (Ford and Hoffmann 1988). It occurs in the Americas, from Southern Mexico to the Atlantic Forest in southeastern Brazil (Ford and Hoffmann 1988; Helgen et al. 2016). *P. flavus* lives in tropical rainforests and dry forests with closed canopies, and it is even known to occur in areas with anthropic influence (Sampaio et al. 2011; Miranda et al. 2018). In Mexico, it is distributed from the east and south of the Sierra Madre, from south of Tamaulipas, San Luis Potosí, and Veracruz to the Yucatán peninsula on the Atlantic slope and in Chiapas, Oaxaca, Guerrero, and Michoacan on the Pacific slope (Monterrubio-Rico et al. 2013; Hernández-Flores et al. 2018). In the state of Oaxaca, it has been recorded in the Municipalities of Jocotepec, San José Chiltepec, San Juan Bautista Valle Nacional, and Santiago Comaltepec in the Sierra Madre (Table 1). Kinkajous seem to be mainly frugivorous/carnivorous but supplement this diet with flowers, seeds, insects, and honey (Ford and Hoffmann 1988).

Both species are classified as Least Concern by the IUCN, however, their population trends are declining (Helgen et al. 2016; Helgen and Reid 2016) and there are significant knowledge gaps regarding their distribution, abundance, and status of their populations in Mexico (Hernández-Flores et al.

Table 1. Records of the Long-tailed weasel (*Neogale frenata*) and the Kinkajou (*Potos flavus*) from Sierra Madre de Oaxaca, gathered from the Global Biodiversity Information Facility (GBIF) and literature. See the distribution of records in Fig. 1.

Species	Record	Locality	Municipality	Coordinates	Collection/publication
<i>Neogale frenata</i>	1	Santa Cruz Tepetotutla	San Felipe Usila	17.72413, -96.55837	This study
<i>Neogale frenata</i>	2	-	San Felipe Usila	-	Briones-Salas et al. 2023
<i>Neogale frenata</i>	3	San Jacinto Yaveloxi	Santiago Choápam	17.350537, -95.837918	This study
<i>Neogale frenata</i>	4	-	San Juan Bautista Valle Nacional	17.7667052, -96.3110315	LSUMZ
<i>Neogale frenata</i>	5	-	Santiago Comaltepec	-	OAX.MA
<i>Potos flavus</i>	6	Santa Cruz Tepetotutla	San Felipe Usila	17.731483, -96.553415	This study
<i>Potos flavus</i>	7	Santa Cruz Tepetotutla	San Felipe Usila	17.730924, -96.560484	This study
<i>Potos flavus</i>	8	Santo Domingo	San José Chiltepec	17.9480556, -96.1716667	USNM
<i>Potos flavus</i>	9	-	Jocotepec	-	Alfaro et al. 2006
<i>Potos flavus</i>	10	La Esperanza	Santiago Comaltepec	17.6291667, -96.3666667	CNMA
<i>Potos flavus</i>	11	Vista Hermosa	Santiago Comaltepec	17.660278, -96.341667	KUM
<i>Potos flavus</i>	12	Vista Hermosa	Santiago Comaltepec	17.6326556, -96.3416988	KUM
<i>Potos flavus</i>	13	Santiago Tepitongo	Totontepec Villa de Morelos	17.298, -96.07165	CNFB

CNFB = Colección Nacional de Fotocolectas Biológicas;

CNMA = Colección Nacional de Mamíferos;

KUM = University of Kansas Biodiversity Institute, Mammalogy Collection;

LSUMZ = Louisiana State University, Museum of Natural Science;

OAX.MA = Colección Mastozoologica, CIIDIR-IPN Unidad Oaxaca;

USNM = National Museum of Natural History, Smithsonian Institution, Mammals Collection.

2018). In Mexico, *Potos flavus* is considered under special protection (Pr) by NOM-ECOL-059-SEMARNAT-2010 (SEMARNAT 2019) while *Neogale frenata* is not included. Here, we present the first confirmed direct records of the Kinkajou and the second direct record of the Long-tailed Weasel in San Felipe Usila municipality, Oaxaca, Mexico, two carnivores with elusive behaviors that are challenging to observe in their natural habitats, which increases knowledge of their presence in this area.

Field surveys were conducted from 2019 to 2023 in the localities of Santa Cruz Tepetotutla and San Jacinto Yaveloxi, Municipality of San Felipe Usila and Santiago Choápam respectively, in the region of Sierra Madre de Oaxaca (SMO) (Ortiz-Pérez et al. 2004) in Mexico. Night monitoring was carried out between 19:00–04:00 hrs through areas of roads and permanent streams. Day monitoring was carried out between 10:00–12:00 hrs through areas of primary vegetation of tropical montane cloud forest and forest areas close to human settlements. In each encounter, the geographical location was recorded using a GPS (Garmin GPSMAP 65), as well as a brief description of the activity of the organisms, and characteristics of the site such as the type of substrate and height. All photographs and videos were obtained using smartphones.

We consulted the available published references (Alfaro et al. 2006; Briones-Salas et al. 2023) and used the rgbf R package (Chamberlain et al. 2023; R Core Team 2023) to obtain previous vouchered records from the Global Biodiversity Information Facility of both species. We incorporated only previously known historical records with coordinates available to create the map (Fig. 1) using QGIS version 3.32 (QGIS 2023).

We report four new records of two carnivore species within the Santa Cruz Tepetotutla and Santiago Yaveloxi localities, situated amidst predominantly in Tropical Montane Cloud Forest (TMCF) and Pine Forest vegetation (Meave et al. 2017; INEGI 2019).

***Neogale frenata* (Lichtenstein, 1831)**

First record. On March 30, 2019, at 11:30 h. In the locality of Santa Cruz Tepetotutla, San Felipe Usila, at coordinates 17.7241°N, 96.5583°W; 1560 elevation. An adult individual was recorded at ground level between mounds of leaf litter. (<https://zenodo.org/doi/10.5281/zenodo.10389547>).

Second record. On March 11, 2020, at 10:00 h. In the locality of San Jacinto Yaveloxi, Santiago Choápam, at coordinates 17.3505°N, 95.8379°W; 920 elevation. A juvenile individual (Fig. 2) was recorded. This individual was found near a human settlement and presented several injuries in the ventral region that led to his death because of a domestic cat.

***Potos flavus* (Schereber, 1774)**

First record. On 20 September 2019, 23:46 h. In the locality of Santa Cruz Tepetotutla, San Felipe Usila, at coordinates 17.7314°N, 96.5534°W; 1260 elevation. An adult individual was recorded resting on a tree branch no more than two meters away from the road at approximately three meters high.

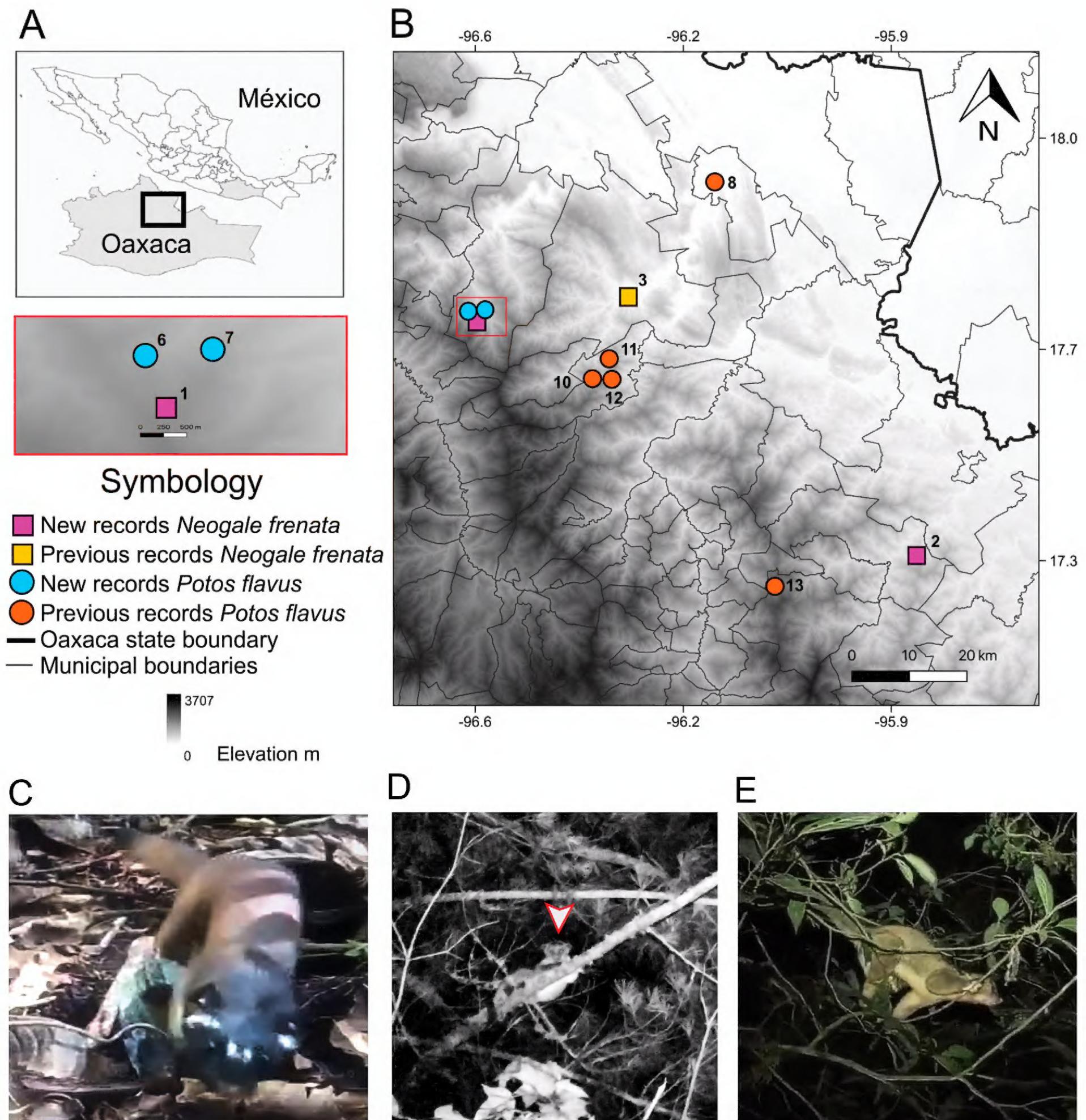


Figure 1. Maps of study area and records of two carnivore species within Sierra Madre de Oaxaca **A** macrolocalization of study area **B** study area **C** first record of *Neogale frenata* **D** first record of *Potos flavus* and **F** second record of *Potos flavus*. For additional details see Table 1.

Second record. On June 27, 2023, at 00:56 h. In the locality of Santa Cruz Tepetotutla, San Felipe Usila, at coordinates 17.7309°N, 96.5604°W; 1260 elevation. Two juvenile individuals were recorded, accompanying each other, active above the tree canopy, at a height of 10 meters from the ground, over a permanent stream (<https://zenodo.org/doi/10.5281/zenodo.10389599>).

We found one of the smallest mammals belonging to Carnivora, *Neogale frenata* and the most specialized for arboreal life, *Potos flavus* in two localities of SMO. Both species are essential for the maintenance of local biodiversity. The *N. frenata* could be acting as a generalist predator of small vertebrates, invertebrates, carrion and as a biological control of populations of *Microtus* and *Peromyscus*.



Figure 2. Juvenile individual of *Neogale frenata* from San Jacinto Yaveloxi, Santiago Choápam, Mexico. Photograph by Hermes Santiago-Dionicio.

(Sheffield and Thomas 1997; Vaca-León et al. 2019). *Potos flavus* visits more than one tree per night, which potentially contributes to cross-pollination (Ford and Hoffmann 1988), as well as a seed disperser (Séguigne et al. 2022).

It is necessary to highlight that, in the case of *Neogale frenata*, even though it had been reported for the municipality of San Felipe Usila (Briones-Salas et al. 2023), no geographical reference was added. Therefore, our record should be taken as the first verified record of *N. frenata* for the locality of Santa Cruz Tepetotutla, Oaxaca. Our second observation of this species provides the first municipality record in Santiago Choápam and the closest record geographically is located 68 km southeast in San Juan Bautista Valle Nacional municipality (Table 1). For *Potos flavus*, both observations are the first records in San Felipe Usila municipality, the closest historical record is located 22 km to the southeast in Santiago Comaltepec (Table 1). Additionally, this species was not previously recorded by Pérez-Lustre et al. (2006) in the checklist of mammals of San Felipe Usila municipality, possibly due to its nocturnal and arboreal habits (Ford and Hoffmann 1988).

For the conservation of species, a fundamental part is the distribution records, which depend on quality and reliability; in the case of mammals, most monitoring is focused on records using passive detection methods (camera traps, records of footprints, or olfactory stations) (Swann et al. 2011; Nakashima 2015). However, for some taxa with different habits (e.g., arboreal) the probability of detection may be lower (Dennis et al. 2010; Haysom et al. 2021). It has been shown that detectability through these passive techniques may be insufficient since their functionality is often influenced by environmental conditions; factors such as rain can affect the functionality of the equipment (Suárez-Tangil and Rodríguez 2021). Therefore, the importance of fauna records through direct encounters is highlighted to complement inventories through conventional methods and to be able to evaluate a complete picture of their interactions

even in areas with human disturbance. In this sense, it's important to mention that all our records of *Potos flavus* were found within areas with some type of human management like agriculture, beekeeping, and ecotourism.

The first record was found on the edge of the dirt road and our second record was around a perennial stream where there are dam structures, and water extraction activities for human use are carried out. While for *Neogale frenata* in San Jacinto Yaveloxi (second record) it was obtained inside the village where the individual was killed by a domestic cat. It's known that domestic cats contribute to the decline of mammals in several regions of the world (Loss and Marra 2017; Trouwborst et al. 2020). Although completely wild cats, in natural environments, tend to be found in low densities, their consumption of mammals is greater, compared to those residing in other types of environments (Murphy et al. 2019). In the case of our observation, we infer that, although *N. frenata* is an elusive mammal, during its juvenile stage it can be vulnerable to domestic cats.

However, currently, for the SMO there are no studies that contribute to effectively evaluating the effect of domesticated fauna on native fauna. Therefore, it is imperative to carry out specific research to evaluate its impact. One of the conservation actions evident in some SMO communities is the Indigenous and Community Conserved Area (ICCA's) (CONANP 2023) whereby by regulation it is prohibited for pets such as cats and dogs to roam freely without supervision (Duran et al. 2012). In addition, this conservation modality has gained great relevance because, thanks to community efforts, these regions host a wide wealth of native and endemic species; however, there are still gaps in information regarding the diversity of species they host (Simón-Salvador et al. 2021).

Our study presents significant new records of two mammals in Oaxaca, Mexico. These findings fill geographical gaps and contribute crucial information about the distribution of *Neogale frenata* and *Potos flavus*, this study shows the sympatry between these two carnivores. These direct encounters offer unique insights into the presence of these elusive carnivores in specific areas, supplementing conventional passive monitoring methods. *N. frenata* and *P. flavus* are essential for the study area as generalist predators and seed dispersers, respectively. These regions host a wide wealth of native and endemic species due to conservation efforts by indigenous people; however, there are still gaps in the distribution records of mammals. We highlight the importance of delving into species' distribution records to increase the available information, which is one of the first steps to developing conservation measures, especially in vulnerable environments like tropical montane cloud forests. In addition, both species are under threat due to habitat disturbance and domesticated fauna. However, further study is required to evaluate the effect of domesticated fauna on native fauna in the Sierra Madre de Oaxaca.

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Additional information

Conflict of interest

The authors have declared that no competing interests exist.

Ethical statement

No ethical statement was reported.

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Author contributions

Conceptualization: CCJC, HSD, MA and AICC participated in developing the idea of this work. Data curation: HSD, MA, AICC and GBE participated in the collection of data and photographic records. Formal analysis: CCJC, HSD, MA and AICC. Software: CCJC was in charge of editing the figures and tables in addition to the distribution map. Writing-review and editing: CCJC, HSD, MA, AICC and GBE were involved in the development of the manuscript.

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Data availability

All of the data that support the findings of this study are available in the main text.

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